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Positron annihilation induced Auger electron spectroscopic studies of reconstructed semiconductor surfaces

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Abstract

The positron annihilation induced Auger spectrum from GaAs(100) displays six As and three Ga Auger peaks below 110 eV corresponding to M4,5VV, M2M4V, M2,3M4,5M4,5 Auger transitions for As and M2,3M4,5M4,5 Auger transitions for Ga. The integrated Auger peak intensities have been used to obtain experimental annihilation probabilities of surface trapped positrons with As 3p and 3d and Ga 3p core level electrons. PAES data is analyzed by performing calculations of positron surface and bulk states and annihilation characteristics of surface trapped positrons with relevant Ga and As core level electrons for both Ga- and As-rich (100) surfaces of GaAs, ideally terminated, non-reconstructed and with (2×8), (2×4), and (4×4) reconstructions. The orientation-dependent variations of the atomic and electron densities associated with reconstructions are found to affect localization of the positron wave function at the surface. Computed positron binding energy, work function, and annihilation characteristics demonstrate their sensitivity both to chemical composition and atomic structure of the topmost layers of the surface. Theoretical annihilation probabilities of surface trapped positrons with As 3d, 3p, and Ga 3p core level electrons are compared with the ones estimated from the measured Auger peak intensities. © 2011 American Institute of Physics.

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Keywords

Annihilation, Auger, Beam, GaAs, Positron, Reconstruction, Spectroscopy, Surface